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Avaliação da precisão e confiabilidade de um tubo de impedância recém construído / Assessment of the precision and reliability of an impedance tube recently built

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Abstract

In the current project, the precision and reliability of an impedance tube recently built at the Department of Computational Mechanics (DMC) of the School of Mechanical Engineering (FEM) of the University of Campinas (UNICAMP) was assessed and refinements were performed in the project in order to improve the overall quality of the results obtained. The major aspects of influence in the precision of the instrument were investigated and reported.

Key words:

Impedance tube, precision, reliability.

Introduction

Currently, there are available at the Department of Computational Mechanics (DMC) of the School of Mechanical Engineering (FEM) of the University of Campinas (UNICAMP) some impedance tubes with different configurations, among which, the smallest diameter is 60 mm that allows tests in frequencies from 125 to 2500 Hz. In order to enable the analysis of small size samples along with the experimentation in frequency bands with superior limit near 6000 Hz, an impedance tube was designed and constructed with nominal internal diameter of 27 mm. In the current project the precision and reliability of the impedance tube recently built was assessed to perform refinements in the project and improve the overall quality of the results obtained. The major aspects of influence in the precision of the instrument were investigated and reported.

Results and Discussion

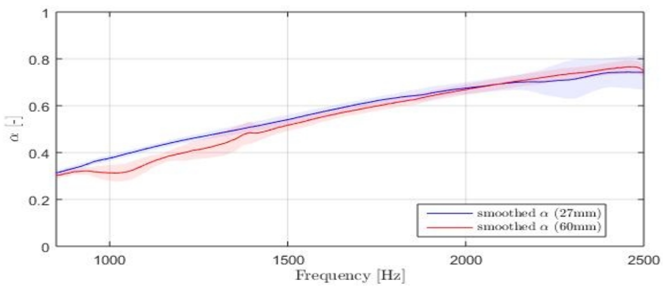

Image 1. Absorption curve comparing a commercial impedance tube and the one built up to 2500 Hz.

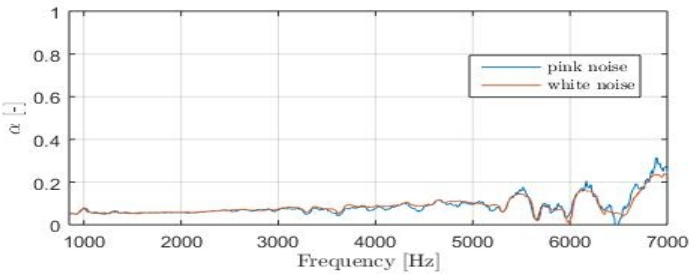

Image 2. Empty tube absorption curve obtained from the built impedance tube.

Investigation was conducted to identify the major aspects influencing the quality of the impedance tube and proper measures were taken, such as re-positioning the microphones, verifying and obstructing possible leakage points and improving the sample holder surface quality. Another aspect taken into consideration was the quality and size of the melamine samples cut, which can create a point of resonance[3]. This resonance is shown in Image 3 represented by valleys when the sample size is not the most appropriate one.

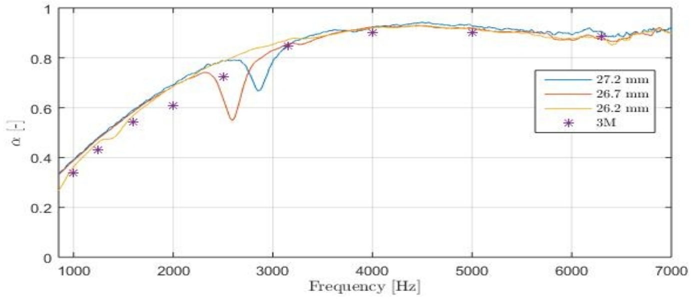

Image 3. Absorption curves comparing tree sample sizes with absorption data provided by 3M.

Conclusions

The impedance tube built was refined and allowed results consistent with what it was expected. This is shown in Image 1, where the results for the absorption coefficient obtained from the built tube was compared to results from a commercial tube from the DMC up to 2500 Hz. In Image 3, the obtained results were compared to results for the same material provided by 3M acoustics laboratories. Finally, it was possible to obtain a curve with low absorption coefficients for empty the impedance tube, as shown in Image 2, with values close to those obtained by commercial tubes.

Acknowledgement

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[1] Norma BS EN ISO 10534 1: 2001, Acoustics – Determination of sound absorption coefficient and impedance in impedance tubes – Part 1: Method using standing wave ratio.

[2] Norma BS EN ISO 10534 2: 2001, Acoustics – Determination of sound absorption coefficient and impedance in impedance tubes – Part 2: Transfer-function method.

[3] Naoki Kino, Takayasu Ueno, Investigation of sample size effects in impedance tube measurements, Applied Acoustics, Volume 68, Issues 1112, November December 2007, Pages 1485-1493, ISSN 0003-682X.